

CLAIMS

What is claimed is:

1. A composition for the in situ removal of scale from a substrate, said composition comprising:

5 (A) a chelating agent having at least two carboxylic acid functional groups; and

(B) a basic agent selected from the group consisting of alkali metal hydroxides, said basic agent establishing a pH of from 7 to 14 in said composition.

2. A composition as set forth in claim 1 wherein said chelating agent (A) is  
10 selected from the group consisting of dicarboxylic acids, polycarboxylic acids, and combinations thereof.

3. A composition as set forth in claim 2 wherein said chelating agent (A) is  
selected from the group consisting of oxalic acid, malonic acid, succinic acid, glutaric  
acid, 1,2-benzenedicarboxylic acid (phthalic acid), 1,3-benzenedicarboxylic acid, 1,4-  
15 benzenedicarboxylic acid, heptanedioic acid, citric acid, and combinations thereof.

4. A composition as set forth in claim 1 wherein said basic agent (B) is  
selected from the group consisting of NaOH, KOH, and combinations thereof.

5. A composition as set forth in claim 1 further comprising water.

6. A composition as set forth in claim 5 wherein said water is present in an  
20 amount from 50 to 75 parts by weight based on 100 parts by weight of total composition.

7. A composition as set forth in claim 1 wherein said chelating agent (A) is  
present in an amount from 5 to 25 parts by weight based on 100 parts by weight of total  
composition.

8. A composition as set forth in claim 1 wherein said basic agent (B) is present in an amount from 5 to 35 parts by weight based on 100 parts by weight of total composition.

9. A composition as set forth in claim 1 wherein said chelating agent (A) is in a 10 to 50 percent solution with water, by weight of said chelating agent (A).

10. A composition as set forth in claim 1 wherein said basic agent (B) is in a 25 to 75 percent solution with water, by weight of said basic agent (B).

11. A composition as set forth in claim 1 wherein said basic agent (B) establishes a pH of from 10 to 14 in said composition.

12. A composition as set forth in claim 1 further comprising a molar excess of said basic agent (B) relative to said chelating agent (A).

13. A composition as set forth in claim 12 wherein said molar excess is from .025 to .075 excess moles of said basic agent (B).

14. A composition as set forth in claim 1 wherein the volume ratio of a 20 to 25 weight percent aqueous solution of said chelating agent (A) to a 45 to 55 weight percent aqueous solution of said basic agent (B) in said composition is from 1 : 4 to 4 : 1.

15. A composition as set forth in claim 1 wherein said chelating agent (A) is a bidentate ligand.

16. A composition as set forth in claim 1 wherein said chelating agent (A) is a polydentate ligand.

17. A composition as set forth in claim 1 further comprising a monodentate ligand.

18. A composition as set forth in claim 17 wherein said monodentate ligand is selected from the group consisting of carboxylic acids having from 1 to 20 carbon atoms.

19. A composition as set forth in claim 1 further comprising at least one additive selected from the group consisting of pH indicating dyes, corrosion inhibitors, polymeric dispersants, and combinations thereof.

20. A composition as set forth in claim 1 including a boiling temperature of from 100 to 120°C.

21. A substrate having at least one surface that has been treated with the composition as set forth in claim 1.

22. A method of removing scale from a substrate, said method characterized by using the composition as set forth in claim 1 to remove the scale from the substrate.

23. A composition for the in situ removal of scale from a substrate, said composition comprising:

- (A) a chelating agent selected from the group consisting of;
  - (i) compounds having at least two carboxylic acid functional groups,
  - (ii) compounds having at least two functional groups, other than carboxylic acid functional groups, that are convertible into carboxylic acid functional groups, and
  - (iii) combinations thereof; and
- (B) a basic agent selected from the group consisting of alkali metal hydroxides, said basic agent establishing a pH of from 7 to 14 in said composition.

24. A composition as set forth in claim 23 wherein said compounds having at least two carboxylic acid functional groups (A)(i) are selected from the group consisting of dicarboxylic acids, polycarboxylic acids, and combinations thereof.

25. A composition as set forth in claim 23 wherein said compounds having at least two functional groups that are convertible into carboxylic acid functional groups (A)(ii) are selected from the group of dicarboxylic acid derivatives convertible into dicarboxylic acids by hydrolysis, polycarboxylic acid derivatives convertible into polycarboxylic acids by hydrolysis, and combinations thereof.

26. A composition as set forth in claim 25 wherein said dicarboxylic acid derivatives convertible into dicarboxylic acids by hydrolysis are selected from the group consisting of diacyl halides, carboxylic acid anhydrides, esters of dicarboxylic acids, dicarboxamides, and combinations thereof.

27. A composition as set forth in claim 23 further comprising water.

28. A composition as set forth in claim 23 wherein said basic agent (B) establishes a pH of from 10 to 14 in said composition.

29. A composition as set forth in claim 23 further comprising a molar excess of said basic agent (B) relative to said chelating agent (A).

30. A composition as set forth in claim 29 wherein said molar excess is from .025 to .075 excess moles of said basic agent (B).

31. A composition as set forth in claim 23 wherein the volume ratio of a 20 to 25 weight percent aqueous solution of said chelating agent (A) to a 45 to 55 weight percent aqueous solution of said basic agent (B) in said composition is from 1 : 4 to 4 : 1.

32. A composition as set forth in claim 23 further comprising a monodentate ligand selected from the group of carboxylic acids having from 1 to 20 carbon atoms.

33. A method for the in situ removal of scale from a substrate, said method comprising the steps of:

5 circulating a first volume of a composition to contact the substrate, the composition comprising a chelating agent having at least two carboxylic acid functional groups, and a basic agent selected from the group consisting of alkali metal hydroxides wherein the basic agent establishes a pH of from 7 to 14 in the composition.

10 34. A method as set forth in claim 33 further comprising the step of heating the composition to from 50 to 110°C.

35. A method as set forth in claim 33 wherein step of circulating the first volume of the composition is conducted for from 1 to 48 hours.

15 36. A method as set forth in claim 33 further comprising the step of inspecting the substrate after the composition has been circulated to determine if the scale has been removed.

37. A method as set forth in claim 36 further comprising the step of re-circulating the first volume of the composition after the substrate has been inspected to remove additional scale from the substrate.

20 38. A method as set forth in claim 37 further comprising the step of filtering the first volume of the composition to eliminate solid particulates in the first volume prior to re-circulating to remove additional scale.

39. A method as set forth in claim 38 further comprising the step of supplementing the first volume of the composition with additional basic agent after the first volume has been filtered.

40. A method as set forth in claim 36 further comprising the step of recirculating a second volume of the composition after the substrate has been inspected to remove additional scale from the substrate.

41. A method as set forth in claim 33 further comprising the step of rinsing  
5 the substrate with water after the composition has been circulated.

42. A method as set forth in claim 41 further comprising the step of passivating the substrate.

43. A method as set forth in claim 42 wherein the step of passivating the substrate is further defined as passivating the substrate with a passivating solution  
10 comprising hydrochloric acid and sodium nitrate.

44. A method for the in situ removal of silicate-containing scale from a boiler, said method comprising the steps of:

circulating a composition within the boiler, the composition comprising a chelating agent having at least two carboxylic acid functional groups, and a basic agent  
15 selected from the group consisting of alkali metal hydroxides wherein the basic agent establishes a pH of from 7 to 14 in the composition, wherein the scale that is removed is silicate-containing scale previously deposited on interior surfaces of the boiler.